Attachment B

Transportation Network (*T*NET) Consortium

Guide Book and Best Practices

King County

REGIONAL
***T*NET**

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Document History

Date	Who	Description
5/28/06	G.H. Goerlitz	Edited BP G-14: eliminate reqmt for vertices in Arc Tool circles

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1 Introduction

1.1 Overview

The Transportation Network (*T*NET) Geographic Information Systems (GIS) Data Maintenance Initiative is a consortium of regional cities, county agencies as well as public/private partnerships participating in maintaining a seamless database of *transportation* related spatial and attribute datasets. These datasets are housed centrally and maintained by transportation planners, city and county engineers, Emergency Response personnel and GIS analysts. This cooperative arrangement permits the availability of a high-accuracy, up-to-date transportation network suitable for a variety of transportation planning, operations, and related business functions throughout the region.

1.2 Background

Historically, there have been several attempts within the Puget Sound to produce an integrated transportation network that works for all agencies. These have generally been less successful because, although being initially integrated, the network diverges as each agency attempts to maintain its copy. These copies were generated for a variety of reasons including the need for data control, the ability to attach related datasets and maintain both efficiently, and different business functions (e.g., planning versus operations). Most importantly, copies were made because there was no way to maintain the entire network at one location and give everyone control.

Data maintenance of transportation network copies did not eliminate the need to occasionally obtain updates for adjacent jurisdictions, areas not regularly maintained, or locations with poor source information. Often, agencies would update their copies quarterly, semiannually or even annually with locally available data CDs or data from street network data vendors. The currency of these data often did not meet business needs, and each update may have required a costly and time-consuming conflation exercise to accommodate other adjacent street networks or business data layers. Transportation networks updated from multiple sources also suffered from a lack of standard spatial and attribute maintenance practices making the resulting data layer difficult to use for some business functions.

1.3 The *T*NET Solution

The *T*NET Program was devised to eliminate the proliferation of data copies for maintenance purposes within public and private agencies throughout the region so that a seamless integrated transportation network could be available to all agencies. This was made possible in part by suitable technologies that removed many of the constraints such as bandwidth. Data maintainers throughout the region can now maintain a local version of the transportation network and regularly synchronize their changes as well as receive changes from others. *T*NET was established to take full advantage of this new capacity.

*T*NET was also devised to eliminate regular conflations of adjacent agency data or improved source information. Each agency that participates in the *T*NET Program offers its data into the combined regional transportation network while retaining control of the disposition of the data it owns. All partner agencies simply continue their current practices by maintaining centrally stored features within their primary area of responsibility. The data store can be extracted for end-user business needs within each agency including linking to agency specific business attributes. Partner agencies maintain their pieces of the central database with the benefit of unlimited access to current cross-boundary data from adjacent datasets. Thus, *T*NET uniquely unifies the varied GIS data maintainers within the region into a cooperative, mutually beneficial consortium to produce a current, high accuracy and multi-modal data product that works for all stakeholders.

1.4 Document Purpose

This document provides a detailed description of the *T*NET system architecture including data, hardware, software, and staffing requirements (Section 2). It also details agreed upon standards, guidelines, and rules for maintaining the transportation network (Section 3). Adhering to these standards is critical to ensure consistency in the transportation network across jurisdictional boundaries.

1.5 Related Documents

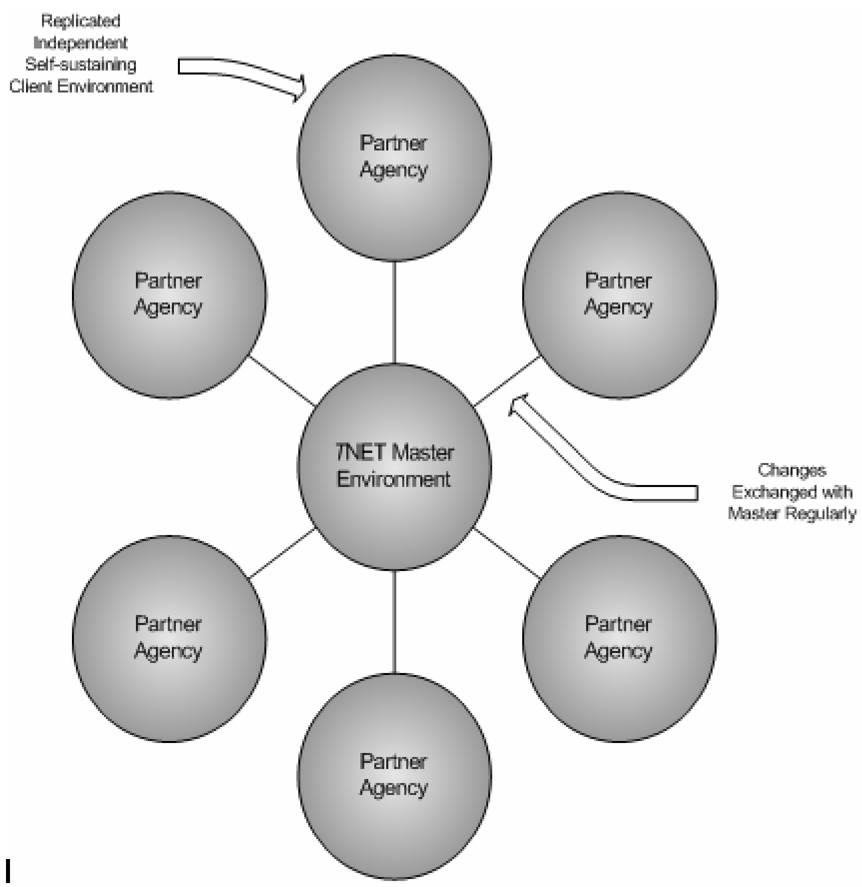
In addition to this Guide Book, there are several related documents that might be of interest to *T*NET Consortium agencies. The *T*NET Consortium Interagency Agreement is a signed document that establishes the respective roles and responsibilities of the parties comprising the *T*NET Consortium, including but not limited to such tasks as (1) maintaining the currency of their respective *T*NET Replicated Databases in a timely manner, (2) regularly synchronizing their data modifications with the *T*NET Master Database, (3) adopting and subsequently adhering in good faith to policies, best practices and business rules, and other elements as are necessary to support the Transportation Network, and (4) and/or administering contract(s) with consultant(s) as deemed necessary by the *T*NET Consortium.

The *T*NET Editor interface includes a fully functioning and searchable help system (in development) that will assist data maintainers in its use. In addition, there are several documents available that describe the *T*NET Editor interface and GO! Sync technology installations. These are intended for system administrators.

The latest versions of these documents are available on the *T*NET website:

http://www.metrokc.gov/gis/Projects/TNET/tnet_main.htm.

2 System Architecture



2.1 Overview

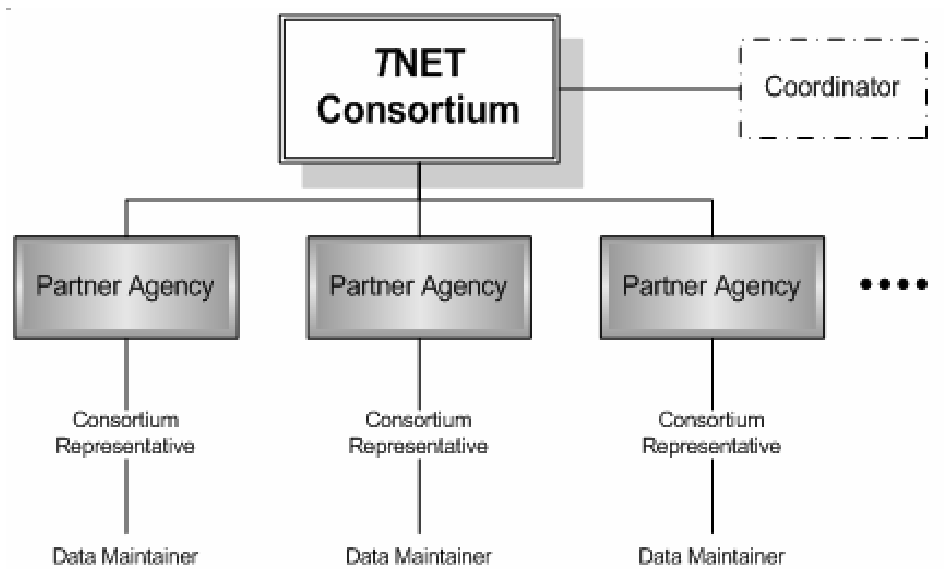
The design of the *T*NET system architecture includes a central master repository and separate replicated independent client environments. Each client environment has its own data, software, and hardware similar to the master environment. Changes made by clients to their replicated data are sent to the master repository and then redistributed to all client sites. This distributed architecture has several key advantages:

- Various software, database, and hardware configurations can be implemented at client sites depending on specific requirements.
- System failures at any one agency or even the master environment would not affect other agency's ability to conduct their own business.
- Business data specific to a single agency can be attached to their replicated copy and maintained without distribution or disruption to other agencies.

This architecture was designed to facilitate data maintenance activities. It does not offer direct access to production ready data by end-users and systems, which often requires database simplification or denormalization, conversion to other formats (e.g., ESRI shapefiles), and deployment to restricted access libraries. Data can be extracted from the maintenance repository for use by internal and external systems and end-users, and to maintain linkages with other business data.

The master repository and the client environments are each composed of four primary components: Partner agencies, data, software including an associated software extension, and hardware including the communication infrastructure. Each of these are essential to achieving the desired goal of an integrated, up-to-date, regional, multi-modal network, developed and maintained following agreed upon standards, and suitable for a variety of transportation functions. These components are discussed in the sections below. System requirements are provided in Appendix A.

2.2 Partner Agencies and the *T*NET Consortium



2.2.1 Description

The most important elements of the *T*NET system architecture are local partner agencies that participate in the *T*NET Consortium. Single representatives from each of the partner agencies form a decision making body that has responsibility for maintaining features of the transportation network – attributes, geometry or both. Thus, each partner agency has an equal voice in the *T*NET Consortium. In most cases, partner agencies currently in the Consortium maintained a digital transportation network for their geographic business area prior to the implementation of *T*NET, and these agencies were logical candidates for the *T*NET Consortium. There is no cost for partner agencies to participate in the *T*NET Consortium beyond normal GIS operating costs for hardware, software, and staff.

Several agencies that do not maintain the transportation network are included in the *T*NET Consortium as non-voting members (e.g., Puget Sound Regional Council and the King County GIS Center). These agencies have an important stake in the decisions of the Consortium and are, therefore, invited to participate in discussions.

See Appendix B for a complete list of all current participants.

2.2.2 *T*NET Consortium Responsibilities

The *T*NET Consortium is a technical decision-making board of professionals who have responsibility for the policies and procedures necessary to ensure the continued suitability of the transportation network to the needs of all members. Decisions impacting the Consortium are arrived at by consensus and typically involve:

- Changes to the database design or attribute editing extension.
- Maintenance standards and best practices.
- Disputes regarding the suitability of source data.
- Acquisition of consultant contracts for performing system-related work.
- Other policy, procedural or technical matters pertaining to Consortium business.

Deliberations often can be adequately conducted via emails or conference calls, but when appropriate the Consortium can schedule meetings at a time and location acceptable to all parties. Where a fraction of the partners are affected but not the whole, only those Consortium partners immediately concerned review and resolve the issue to their respective satisfaction, informing the Consortium of such decisions as a matter of courtesy.

Refer to the *T*NET Interagency Agreement for a complete review of *T*NET Consortium procedures and responsibilities.

2.2.3 Agency Responsibilities

Each agency within the Consortium is responsible for:

- *Maintenance in a timely manner of geographic features within a specific area, attributes of those features (e.g., addresses), or both.* Maintenance responsibility varies between agencies. Many agencies such as cities and King County Road Services maintain a geographically constrained portion of the network coincident with their jurisdictional boundaries. Other agencies such as E-911 and King County Metro Transit maintain transportation features throughout the network. Each agency benefits from the timely and accurate maintenance activities of other Consortium members.
- *Participation in the TNET Consortium.* Upon joining the *T*NET Consortium, a partner agency will be asked to designate a representative and an alternate (if feasible) to participate in Consortium administrative decision-making, such as modifications to the database and/or custom application designs. Agencies must also provide contact information for data maintenance personnel (editors). Normal day-to-day communications among the Consortium partner representatives and agency editors will be an expected practice, contributing significantly to both the currency and the seamlessness of the regional database. The roles of representative and editor could be combined in one individual or assigned as the size and business needs of the partner agency require. Representatives and editors will communicate as necessary to address organizational and technical issues. The Consortium representative will be expected to apprise editors of the standards and best practices for data maintenance as well as meet as needed with other Consortium members.
- *Providing and supporting specific hardware for housing the TNET infrastructure at the agency.* Depending on how *T*NET is implemented at an agency, a partner agency may need to identify a Microsoft Windows server(s) that will 1) provide the communications link to the master environment; and 2) house the agency's replicated version of the

*T*NET database. The configurations and specifications of this hardware are detailed in Section 2.5 and Appendix A.

2.2.4 King County Metro Transit Responsibilities

King County Metro Transit has three distinct roles within the *T*NET Program:

- *Maintain Transit specific pathways.* King County Metro Transit participates in the *T*NET Program as other Consortium partners with the responsibility of data maintenance for all features within Metro's jurisdiction such as streets at park and rides, bases, transit centers, the transit tunnel, and the E-3 busway. Transit also is responsible for data maintenance of features that extend outside of King County such as freeways, state routes, and roads necessary for routing buses in adjacent counties. Finally, to achieve complete geographic coverage, King County Metro Transit has assumed the responsibility at maintaining any "unclaimed" geographic areas within King County.
- *Support the Master environment and each agency's implementation of TNET infrastructure.* As described in Section 2.1, the logical *T*NET architecture consists of a central master repository that is replicated to each participating agency. King County Metro Transit is responsible for managing the entire infrastructure of the master repository including the database, the software, developed applications, and hardware (including a separate test/development environment). Support activities include monitoring the *T*NET system; ensuring access by Consortium members; maintenance and administration of ArcSDE; ensuring the proper functioning of the connectivity infrastructure; server support; application maintenance; database maintenance and software upgrades; as well as operating system maintenance and upgrades. King County Metro Transit will also provide assistance to all participating agencies in the support of their respective agency environments. Support contact is provided through a group email monitored by Transit GIS Staff (tnet@metrokc.gov).
- *Coordinate the TNET Consortium.* King County Metro Transit will serve as coordinator for the *T*NET Consortium. This includes coordinating editing conflicts between agencies; ensuring the proper and consistent implementation of the data maintenance standards; providing informational seminars to technical staff, management, and decision makers as requested; hosting and maintaining a *T*NET Website for communication purposes (http://www.metrokc.gov/gis/Projects/TNET/tnet_main.htm); and hosting Consortium meetings as needed.

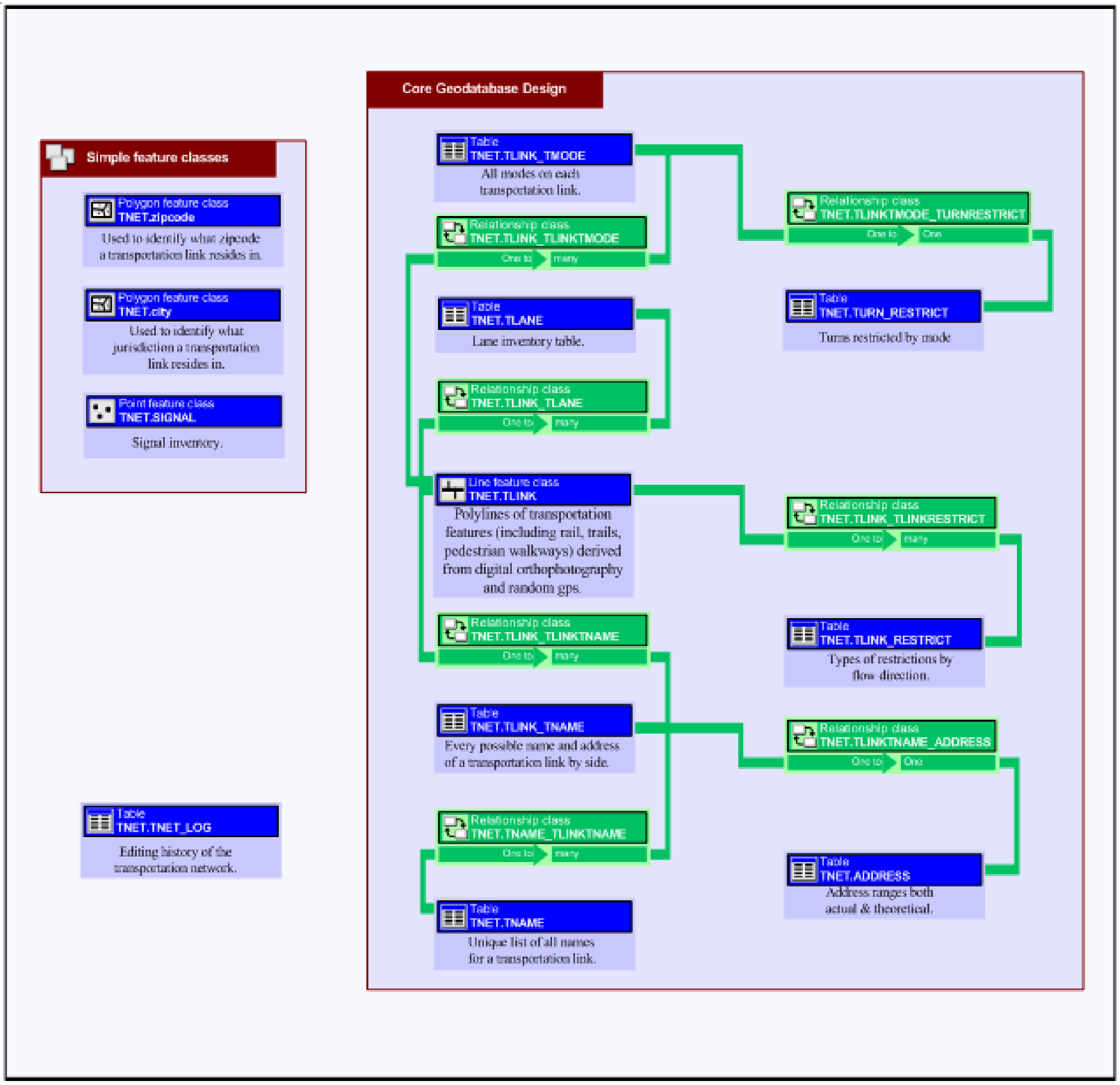
2.3 Data

2.3.1 Description

The *T*NET repository includes spatial features that represent real-world locations for transportation features, attributes describing those features, and data maintenance rules to ensure quality. The primary source for the spatial features was 1998 digital orthophotography with updates from photography that was flown in late 2002. Features were captured following specific photogrammetric procedures achieving a positional accuracy of 10 feet or better in most areas. The database includes features for a variety of transportation modes such as vehicular, pedestrian, bicycle, bus, rail, water, and equestrian. These modes are integrated together to facilitate traversal operations between mode pathways. This makes *T*NET suitable for many transportation operational and planning functions. King County represents the primary extents of *T*NET with additional features in Snohomish and Pierce Counties for features used by cities on the King County border as well as freeways, state routes, and other major roads necessary to route transit vehicles. Consortium members now maintain the *T*NET data using appropriate sources.

In addition to spatial features, the database has been designed to store a rich set of attributes for each transportation network feature. Attributes such as names, theoretical address ranges, road class, and others have been initially populated from existing King County or GDT transportation data. Specific data were not available for other attributes such as number of lanes and actual address ranges, but these attributes are useful and were included in the database design. It is anticipated that Consortium partners will populate these during ongoing data maintenance.

2.3.2 Database Design



The *T*NET database design was patterned after the UNETRANS development effort -- Unified Network-TRANSportation. The UNETRANS project (http://www.ncgia.ucsb.edu/vital/unetrans), funded by ESRI, set out to develop a generic data model for transportation applications, using

ESRI's ArcGIS 8 software. This was part of ESRI's series of “essential data models” in various industry groups. It is a starting point, not an imposed standard; and users can modify the template as needed to suit particular purposes. UNETRANS was developed in consultation with a consortium of users: highway agencies and DOTs, transit and rail organizations, city departments and airport authorities, planning consultants, software developers and university faculty in North America, Europe and the Pacific Rim.

From this base model, the *T*NET physical design was generated to meet the business needs of participating agencies for data maintenance of the King County transportation network. It consists of a single simple feature class (TLINK); attribute tables for modes, lanes, turn restrictions, use restrictions, addresses, and names; and relationship classes that associate the simple feature class to the attribute tables or the attribute tables to each other. Additional simple feature classes for polygon features representing zip codes and cities are included and used to provide default attribute values for new features. There is also a log table to track changes to features. A more detailed database design is available from the *T*NET website (http://www.metrokc.gov/gis/Projects/TNET/tnet_datadevelopment.htm).

2.3.3 Replication and Synchronization

The *T*NET master database repository is housed on King County Metro Transit production servers as a versioned ArcSDE data layer. Agencies maintain a replicated ArcSDE layer or personal geodatabase at their sites and synchronize their changes with the master database. Changes submitted by other clients are, in turn, synchronized with each agency’s local version. This two-way synchronization process of a replicated *T*NET database with the master repository ensures that all Consortium members have the most current version of the transportation network locally available in their RDBMS of choice (Oracle, SQL Server, or PGDB). Synchronization occurs during the beginning and ending of an editing session.

2.3.4 Versioning

Versioning permits multi-user editing of the same data layer. Each agency has its own named version within the repository and synchronization of changes is made against these versions. Reconciliation of these changes and posting to the default version will occur regularly. It is expected that few if any data conflicts will arise since most agencies maintain data within geographically constrained regions defined by their jurisdictional boundaries. Any data maintenance conflicts that do occur will be identified and targeted for resolution the next business day. Within an agency, multiple editors might each have their own version. These must be reconciled and posted by staff within the agency to the agency default version prior to synchronizing the agency default with the *T*NET master repository.

2.3.5 Quality Assurance

The *T*NET data must meet the needs of all agencies participating in the Consortium. As such, four mechanisms have been put in place to help assure quality:

- The *T*NET database itself is designed with specific rules that control data quality such as coded value domains, range domains, connectivity, and topology. These rules were initially defined during the development of *T*NET and are now managed by the Consortium. See Appendix C for a detailed listing of these rules.
- The *T*NET Editor, a custom ArcGIS extension, is used in maintaining the attribute data. It assists users in their interactions with the database through a variety of application

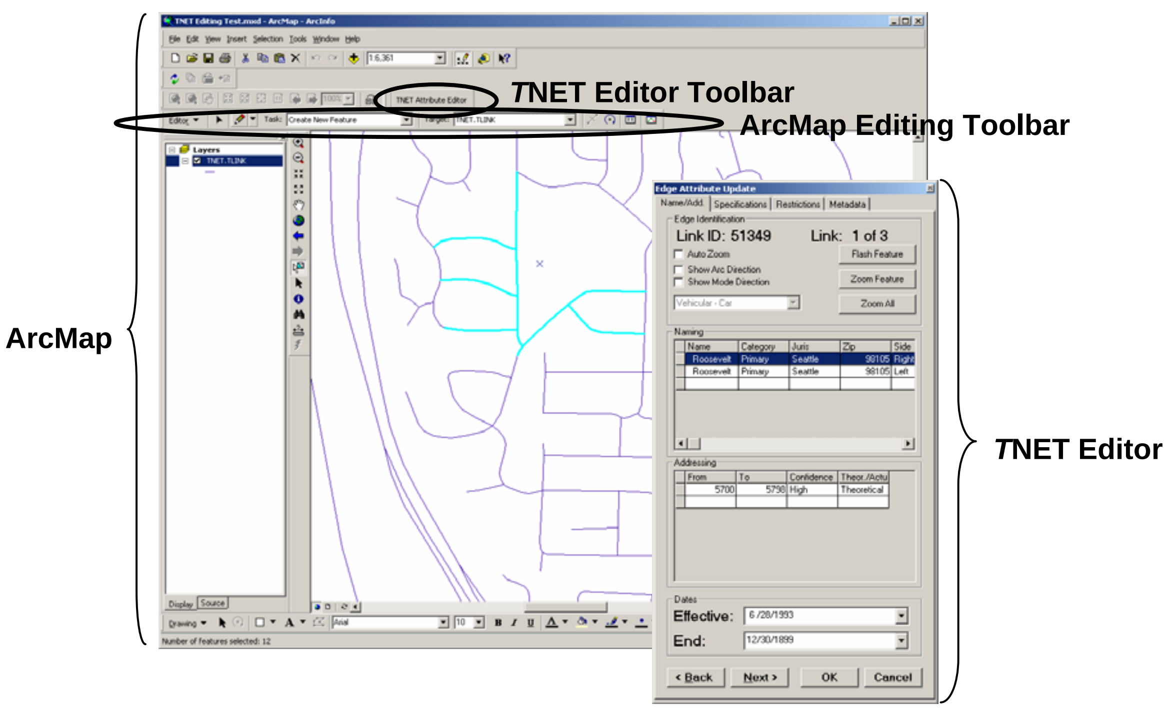
controls. Dropdown lists, calendar controls, and check boxes guide data maintainers and assure consistency in feature attribute coding. See Section 2.4.2 and Appendix C.

- A series of written best practices, standards, and maintenance guidelines were designed for rules that could not be incorporated into the geodatabase or rules that would have unduly restricted agencies from meeting their business needs. These best practices were initially defined during the development of *T*NET and are now managed by the Consortium. Each agency is expected to adhere to these best practices. See Section 3.
- In its role as coordinator and maintainer of the master repository environment, King County Metro Transit will monitor the system and the data maintenance operations performed by each agency. The purpose here is not to supervise, but to identify as early as possible any issues that might arise from distributed data maintenance and coordinate a solution. This monitoring will be achieved using nightly batch processing routines and inspection of system logs. Nightly processing will also serve to automatically notify partner agencies of data maintenance activity within their jurisdiction.

2.3.6 Public Access

The public and non-partner agencies can access *T*NET data from distribution mechanisms such as the King County GIS Center's public library, CD sales, and iMAP web site (http://www.metrokc.gov/gis/mapportal/iMAP_main.htm). King County Metro Transit will regularly provide a copy of *T*NET to the King County GIS Center. Agency sites are free to distribute *T*NET or portions of the network as required by their own business needs and as authorized by the *T*NET Consortium. Appropriate disclaimers, metadata, and restrictions on third party distribution should be included with the data.

2.4 Software and Application Extension



2.4.1 Description

*T*NET data must be maintained using ArcMap and the *T*NET Editor.

ArcMap is used to modify existing geometry and to create new features. No modifications were made to the functionality of ArcMap for *T*NET data maintenance, and editors may use any spatial editing functions provided with the software. Each partner agency must supply its own local ArcGIS installation and an ArcEditor or ArcInfo license. Agencies using ArcSDE must also provide ArcSDE installation and licenses, and installation and licenses for the RDBMS of choice (Oracle or SQL Server). Support for each Consortium member agency's databases, software, and hardware is the responsibility of that individual agency.

The *T*NET Editor is an application extension of ArcMap and is used to maintain the attributes of features. Each Consortium partner agency is provided a copy of the extension for use within their agency as well as training and assistance with using the interface. The extension must be installed for the system to function properly.

2.4.2 The *T*NET Editor

The *T*NET Editor was designed to permit management of all attributes within the database. Four tabs comprise the extension:

- Name/Add – Access to feature names, aliases, and addressing as well as effective and end dates.
- Specifications – Access to feature specifications such as road classification, height and weight restrictions, etc.
- Restrictions – Access to:
    a. Mode permissions for any of the supported modes.
    b. Use restrictions such as HOV or Transit Only lanes.
    c. Turn restrictions from one feature to another.
- Metadata – Access to documentation on feature level changes.

At the top of each tab is the feature identification, as well as functions to permit display changes. At the bottom of each tab are functions that permit advancing to the previous or next feature when more than one feature is selected. This allows editing the attributes of multiple features without having to dismiss the *T*NET Editor interface.

2.4.3 Editing the Transportation Network

The following steps are required to edit the transportation network:

- Launch ArcMap.
- Add data. Using the add theme button on the ArcMap toolbar, add the *T*NET geodatabase and any supporting layers as required (e.g., digital orthophotography).
- Activate the *T*NET extension. From the ArcMap menu bar, select the Tools => Extensions… option and check the *T*NET Editor in the resulting form. This will force the *T*NET toolbar to appear, which has a single button for launching the *T*NET attribute editing interface. The toolbar can be docked to the ArcMap interface if desired.
- Activate the ArcMap Editor toolbar. Right click on the tool bar area and select the Editor toolbar for access to basic editing functionality.

- Start Editing. From the ArcMap Editor toolbar, start editing by clicking the Editor => Start Editing function. The GO! Sync technology will automatically synchronize and accept any changes submitted to the master repository by other partner agencies.

Alternatively it would be possible to bypass several of these steps by creating a pre-configured ArcMap project that includes the appropriate data and activated extensions/toolbars.

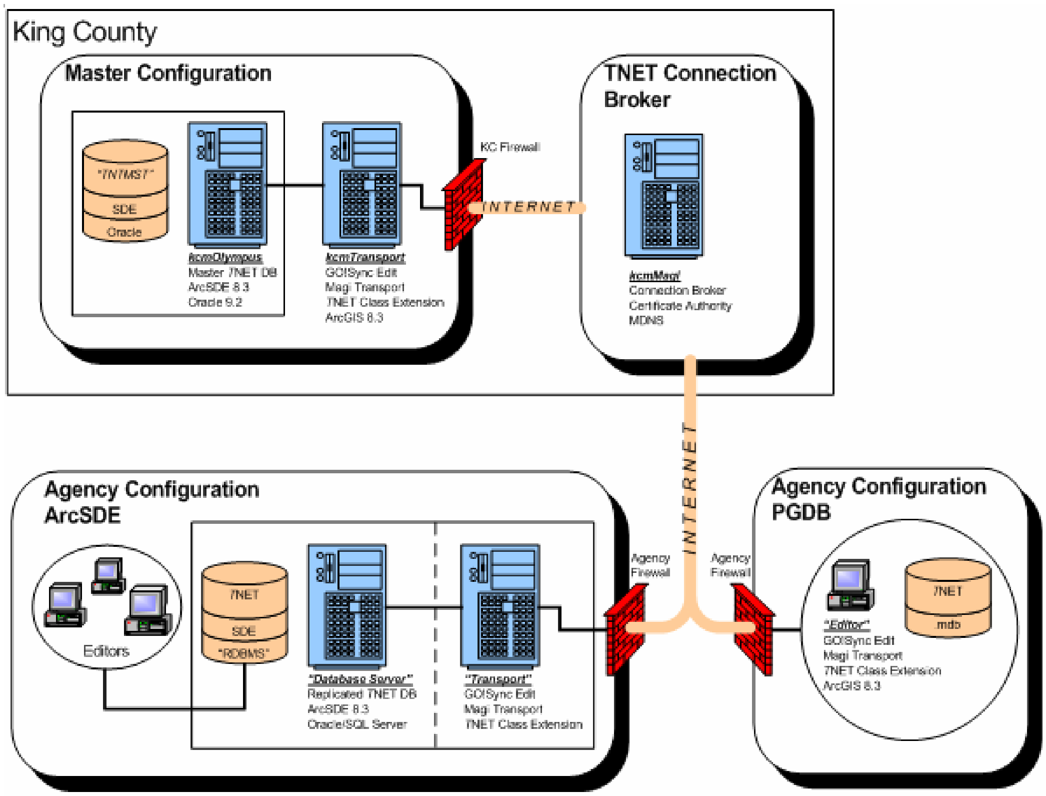
During the session, geometry is edited using standard ArcMap tools. Attributes are edited using the *T*NET Editor on selected features. Attributes should not be modified by opening the attribute table in ArcMap or through the ArcMap attribute-editing tool  as these bypass controls within the *T*NET Editor that ensure data integrity.

When edits are saved, the GO! Sync technology will automatically synchronize and submit any changes to the master repository. Stopping editing without saving or quitting ArcMap without saving will prevent synchronization.

2.4.4 History Tracking

A requirement for the *T*NET system is the ability to retain geography and attributes of closed or eliminated features. This is necessary for historical analyses such as the effect of safety improvements along a road segment, or how traffic patterns have changed through time. At the release of this document, retention of the historical state of changed features is not possible although a log is kept documenting changes to each feature. “Destructive” changes such as splitting, unsplitting, or outright deletion of features are immediate and permanent upon saving changes. The effective dates on the first tab of the *T*NET Editor permit closing a feature to conveyance for a specified period. It is expected that soon after production release, the technology will be available to satisfy the history requirement.

2.5 Hardware and Communications Infrastructure



2.5.1 Master Configuration Description

The *T*NET master configuration includes two servers. One stores the *T*NET central data repository and the other is the master transport, which is used to process incoming changes against the database. See Appendix A for hardware specifications. The master data repository server includes the master database, *T*NET data, ArcSDE, and RDBMS. (The master RDBMS is currently Oracle although a migration to SQL Server may be possible given support requirements and funding).. The master transport includes ArcGIS, the *T*NET Editor, and the GO! Sync technology.

The master transport receives incoming changes from agency data maintainers as part of the synchronization process and automatically replays these against the master database using an ArcGIS and *T*NET Editor installation on the server. This is the only way the *T*NET master data is edited, although the database itself might undergo reconciliation, posting, and compression activities performed by support staff at King County Metro Transit. The master transport also serves to package changes and deliver them to agencies to complete the synchronization process. Key to this synchronization process is the GO! Sync technology from Tadpole-Cartesia. This technology includes GO! Sync Edit, which interfaces with ArcGIS to translate geographic and attribute changes to and from small HTML files. The GO! Sync technology also includes Magi, which manages the secure communications of these files through the system.

Support for all hardware and vendor software installed as part of the *T*NET master configuration are the responsibility of King County Metro Transit.

2.5.2 The *T*NET Connection Broker

The *T*NET connection broker is located outside the King County firewall on the public access segment of the King County WAN, and serves as the pass-through device for agency changes both to and from the master database. The connection broker's purposes are authentication of users and distribution of data changes. See Appendix A for hardware specifications.

Support for all hardware and vendor software installed as part of the *T*NET connection broker are the responsibility of King County Metro Transit.

2.5.3 Agency Configuration Variations

The *T*NET environment within participating agencies closely mirrors the master configuration. The replicated database, ArcGIS, and the GO! Sync technology require storage locations on an agency server(s). Agencies do, however, have flexibility within their environment.

- Agencies who have implemented ArcSDE and an RDBMS can take advantage of that technology. The GO! Sync technology is supported with either Oracle or SQL Server in an ArcSDE environment.
- Agencies who have not implemented ArcSDE or who desire a simplified environment can use a personal geodatabase (PGDB) to store and maintain the transportation network. The environment limits an agency to a single concurrent editor and in most situations the transport technology is installed directly on the users desktop. Synchronization would occur when the user logs in, launches ArcGIS, and starts *T*NET editing.
- The *T*NET database and transport functions can be combined onto a single server or sized appropriately for separate servers. It is a requirement, however, to have the server with the transport technology permanently logged in as an administrator to facilitate synchronization. The screen can be locked for security, but this requirement should be taken into consideration if combining database and transport functions on the same server.

Regardless of the selected agency configuration variation, it is recommended that agencies initially implement *T*NET data maintenance activities separate from other business functions. It must be remembered that the sole purpose of the *T*NET Program is transportation network data maintenance. Other business functions can be integrated later once impacts to agency work flows or transportation network data maintenance activities are identified and mitigated.

3 Data Maintenance Best Practices

This section details system, geographic, and attribute data maintenance best practices that ensure data integrity and quality. Consortium agencies are expected to adhere to these practices and familiarize their data maintenance staff with them. These best practices are also under the control of the *T*NET Consortium and can be modified as appropriate. Specific questions should be forwarded to the *T*NET support team for clarification (tnet@metrokc.gov).

3.1 System

S01: *The TNET database should be maintained using ArcGIS 8.3, and SDE 8.3 (or PGDB).*

The application and database depend on the 8.3 version of ArcGIS and SDE for proper operation. Do not upgrade ArcGIS or SDE for *T*NET data maintenance without first consulting with King County Metro Transit.

S02: *The TNET database should be stored in Oracle or SQL Server if using ArcSDE.*

The GO! Sync technology that manages the synchronization process supports these RDBMSs.

S03: *All public and private transportation network pathways accessible by any of the supported modes should be included in the TNET database.*

The *T*NET database is designed to be a multi-modal transportation network and to support trip planning, E911, and other applications. All pathways are necessary to serve these needs including private roads, pedestrian pathways, trails in parks, and other conveyances. Short driveways to personal residences are not required.

S04: *Planned transportation network features should not be included in the database.*

The transportation network represents real world features currently in operation. It is used for routing emergency response vehicles, transit, pedestrians, and other functions that would be hindered by the incorporation of planned features. Planned features may only be entered if they are physically completed and are open to conveyance within a relatively short time. Use the effective date to indicate the expected opening date.

S05: *Agencies should synchronize with the master repository regularly.*

Synchronization not only sends an agency's changes to the master repository, but also permits the agency to receive changes from other organizations. Even if the agency has no edits to make, regular synchronization ensures agencies have the latest changes by other agencies on the border of their jurisdiction, as well as changes made internally to their jurisdiction on transit properties or by E911.

S06: *Agencies should maintain features in a timely fashion.*

The transportation network is used for emergency response, trip planning, and a variety of other functions that benefit from timely updates. Agencies should actively seek source data on alignment or attribute changes to existing features or information on new features, and enter this information regularly to the *T*NET database.

S07: *Agencies should only modify features for which they have jurisdiction.*

In most cases, agencies maintain a geographically constrained portion of the network coincident with their jurisdictional boundaries. Agencies are expected to coordinate with adjacent jurisdictions when maintaining border features. This might involve exchanging source data or permitting an agency to modify features in your jurisdiction to facilitate a smooth transition in alignments across the border. Both agencies will be notified in the event that nightly data integrity checking identifies features modified by one agency that exist within another agency's boundary. This allows the agencies to evaluate the work performed and act accordingly.

3.2 Geographic

G01: *Features should be drawn based on the center of the physical constructed pathway.*

The center of the physical feature is a measurable location on most source photography, engineering drawings, and physical plans, and should be used when drawing the digital pathway. Typically, what might be colloquially referred to as the painted "centerline" is also visible and can be used for roadways, which make up the largest part of the network. The center of the physical roadway, however, overrides the paint stripe for the digital representation in situations where these two are significantly different (e.g., roads with two lanes in one direction and one lane in the other direction).

Pathways in the transportation network are intended to convey the functional alignment of physical features as closely as possible while not following every minute variation in shape. Where there are short variations in physical features, the digital pathway should represent the trend of the feature. That is, do not jog for every displacement of the paint stripe or pavement, but do reflect the alignment if the change of direction is representative. Conditions that would not normally cause a deflection in the alignment are short left turn lanes at intersections, small traffic circles at intersections, and chicanes or other traffic calming devices.

G02: *Feature geography should have a minimum global accuracy of +/- 10 feet.*

Global accuracy is an assessment of how closely a described position matches the true position. The ten (10) foot minimum target is intended to identify a standard for acquiring source materials for adding new or correcting existing features. If the best available source information is greater (i.e., less accurate) than this target, then it should be used and documented until more accurate sources are acquired.

G03: *Feature geography should have a minimum conformal accuracy of +/- 5 feet.*

Conformal accuracy is an assessment of how closely a segment describes the shape of the real world feature that it models. The five (5) foot minimum target is intended to identify a standard for drawing features and the placement of vertices such that segments of curved features remain within the defined boundary of the feature and approximate the center of that feature. To some extent, a data maintainer's ability to do this is based on the quality of the source data. If the best available source information leads to features being drawn that do not meet this standard, then it should be used and documented until more accurate sources are acquired.

G04: *Features should contain the minimum number of vertices necessary to describe the feature.*

Too many vertices increase database size, can pose problems when reshaping, and are unnecessary. Too few vertices would not accurately describe feature alignment. Straight features should be drawn with no vertices unless the physical feature deviates from a straight line by more than five (5) feet. When drawing features using ArcMap tools that result in true curves, vertices should be inserted approximately every ten (10) feet to ensure that conversion to shapefile results in retention of proper alignments. The conversion will insert an additional vertex between existing ones. Curved features that are not drawn using true curves should be constructed of short tangents approximating the shape of the feature and not deviating from the physical centerline by more than five (5) feet.

G05: *Features should only be replaced by more accurate geography from a documented source.*

The primary source for the spatial features was 1998 digital orthophotography with updates from photography that was flown in late 2002. Features were captured following specific photogrammetric procedures achieving a positional accuracy of ten (10) feet or better in most areas. Review the feature level metadata to ensure alignment changes do not degrade existing feature accuracy.

G06: *Features should be drawn from the most accurate and most current sources available.*

Accuracy and currency should be considered when using source information. The latest digital orthophotography may not be the most accurate, but may be the only source for recent construction. Similarly, the most accurate source digital orthophotography may be "old" and missing new or physically realigned features.

G07: *Feature additions or modifications should be accompanied with appropriate metadata documenting the changes.*

The *T*NET database supports feature level metadata that documents the source for changes and a user comment describing the changes. This information is vital to ensure the ongoing quality of the data.

G08: *Features should be drawn as continuous polylines from intersection to intersection.*

The *T*NET database is designed to eliminate the need for pseudo nodes, which increase database size and are generally unnecessary. Agencies should use events to identify attribute changes within a single polyline for business tables. Pseudo nodes should only be created when an existing attribute changes in value (e.g., speed limit, zip code). Existing pseudo nodes with no change in any attribute value will be eliminated by King County Metro Transit as legacy systems are adapted to this practice.

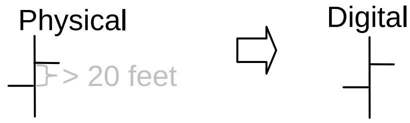
G09: *Features should include elevation values.*

In the near future, the *T*NET database will be adapted to store elevation values along features. These will be populated using a suitable digital elevation model (DEM) and will be the responsibility of King County Road Services to update for new features or update all features when a new DEM becomes available.

G10: *Features or groups of features should not be disconnected (orphaned) from the rest of the network.*

The transportation network is designed to permit feature traversal throughout the network. Multiple modes are included to allow for access to mode pathways that would otherwise be inaccessible (e.g., water features for access to roads on islands). Care should be taken when creating new features to connect these to existing transportation network features. (See ArcMap help for configuring the snapping environment.) The only exceptions are features that are only accessible by air – an unsupported mode in *T*NET.

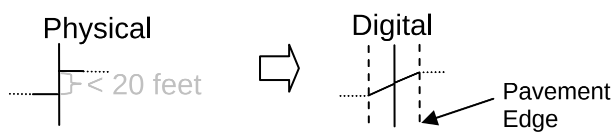
G11: *Features that cross with an offset of more than twenty (20) feet should have that offset preserved.*



The accuracy targets for the *T*NET data justify retention of jogs that are greater than twenty (20) feet. This is the case even if there is a single traffic light at the intersection. Each cross-segment of the feature should be snapped to the primary feature.

G12: *Features that cross with an offset of less than* twenty (20) *feet should have that offset eliminated.*

The accuracy targets for the *T*NET data justify the elimination of jogs that are less than twenty (20) feet. These jogs should be eliminated by creating a vertex on both sides of the cross-feature within the pavement boundary of the straight feature. The end points of the cross-features should then be moved and connected such that they meet at the midpoint of the jog.

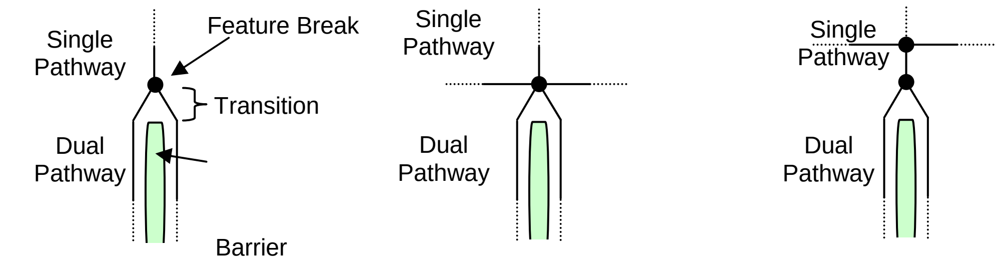


G13: *Features that are physically separated by barriers, medians, planter strips, etc. or a vertical or horizontal separation should be drawn as separate pathways. Features drawn as separate pathways should transition to a single pathway where the physical barrier no longer occurs.*

This guideline is intended to provide general direction on how to draw features with barriers. In most cases, a barrier separates opposing traffic lanes, but it can separate lanes following the same flow as in the I-90 Mt. Baker tunnel. Candidates for separate pathways depend upon the following considerations:

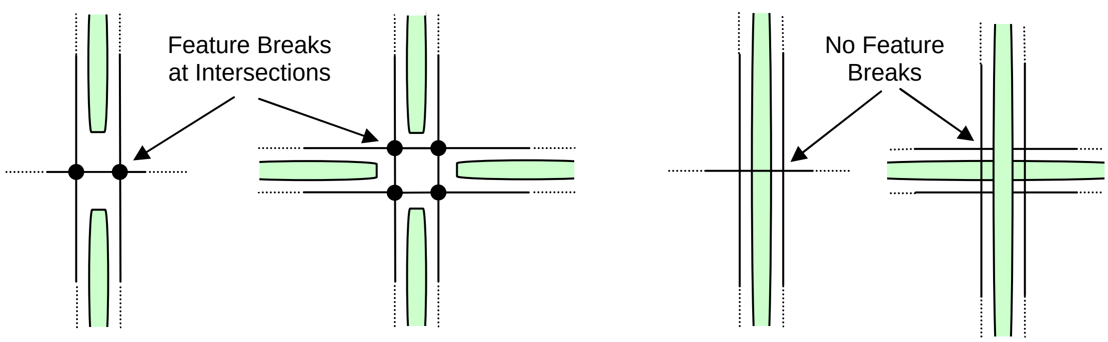
- Length of physical barrier (> 300 ft) -- Long physical barriers prohibit u-turns for emergency vehicles.
- Overall width of the feature – Generally, use separate pathways if the feature has more than a total of 4 lanes for both directions (total width greater than approximately 40 feet). The goal is to permit association of vehicles equipped with GPS to a center alignment. This becomes more problematic with wide features.
- Barrier blocks a cross-feature – Use separate pathways if a cross-feature is not capable of crossing the feature. Although this situation is handled in *T*NET with turn restrictions, it facilitates similar restriction analysis in other software.
- Vertical or horizontal separation – Use separate pathways if the feature is separated vertically (as in Spokane Street between I-5 and West Seattle) or horizontally (as in the HOV lane on southbound I-5 just before I-405 near Sea-Tac Airport).

The transition from two pathways to one should be about as long as the width of the two pathways as illustrated below. If the physical barrier is removed at or near an intersection only enough to accommodate a short left turn lane, then the transition should terminate at the intersection. If the barrier is removed within a sufficient distance to permit left turns into private drives prior to the intersection, then the transition to a single pathway can occur prior to the intersection.



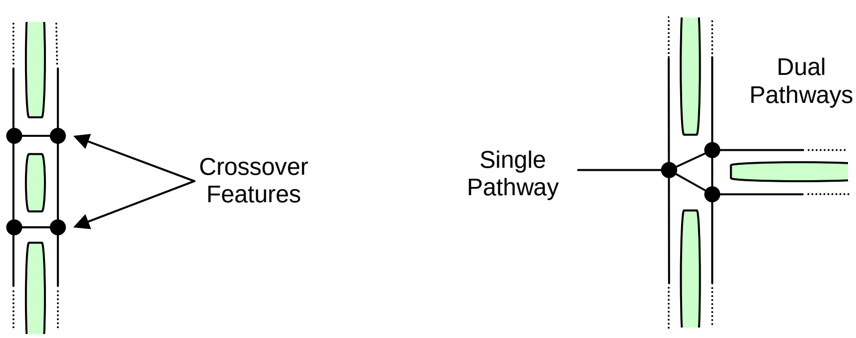
Transition from dual to single pathway | Transition at intersection | Transition prior to intersection

If the barrier breaks for the intersection and then continues on the other side of a cross-street, then no transition should be represented as illustrated below, but the features should be split at the intersections to permit turning. This should also be the methodology used in the unusual case of two intersecting dual pathway features. Features that are vertically separated from each other as with overpasses and underpasses do not need to be digitally split and connected at the end points. If they are, turn restrictions should describe the inability to get from one to the other.



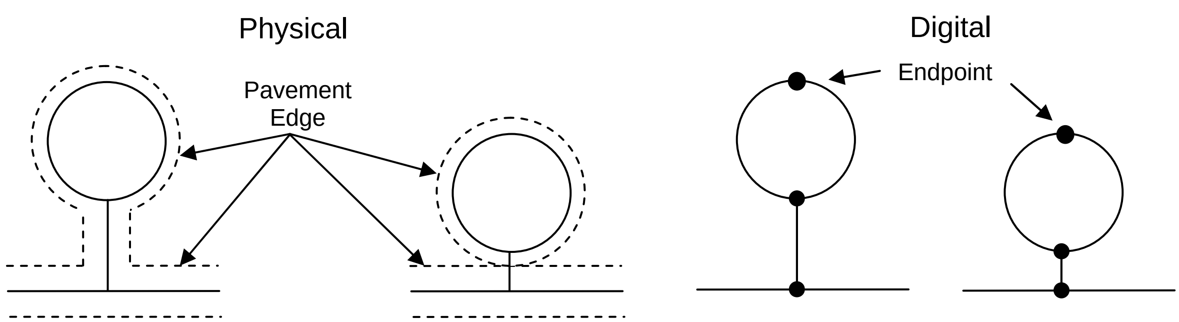
No transition for continuing barrier | No physical or digital feature connection.

If a gap in the barrier exists to permit u-turns or access to driveways, then a crossover feature should be created. Crossovers can also be used to transition from a dual pathway to a single pathway as illustrated below.



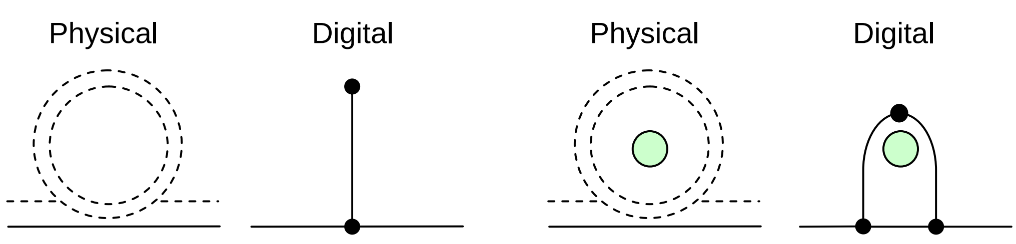
G14: *Cul-de-sacs should be drawn when the edge of pavement of the "circular" portion is tangent to or is beyond the edge of pavement of the feature. Cul-de-sacs should be drawn as three distinct features: One feature representing the "straight" portion and two features representing the "curved" or "circular" portions. The circular portion, whether drawn by heads-up digitizing or using the ArcEditor arc tool, must be split in order to allow odd and even addressing to match the straight portion. If produced by heads-up digitizing, the two halves of the curved or circular portion of the cul-de-sac should contain a minimum of one vertex per five feet of ground distance.*

Functionally, a cul-de-sac is a widening of the pathway at its end permitting average size vehicles to perform a u-turn without having to back up the vehicle. Drawing cul-de-sacs as three distinct features permits proper addressing on the left and right sides. The straight portion should have even addressing for one side of the street and odd addressing for the other. One curved portion should have even addressing on the outer edge and zero addressing on the interior (the side of the feature facing to the center of the circle). The other curved portion should have odd addressing on the outer edge and zero addressing on the interior. Draw cul-de-sacs with minimally one vertex per five foot intervals using the Sketch Tool. Vertices need not be added if using the ArcMap Arc Tools. Schematics illustrating these features are provided below.



Widening edge of pavement misses or is tangent to linear feature edge of pavement

If the edge of pavement of the widening is within the pavement for the linear feature, then the widening is a bulge or knuckle and should be represented as illustrated below. In the unique case that an island exists at the center of the bulge, a distinct pathway around the island should be represented.



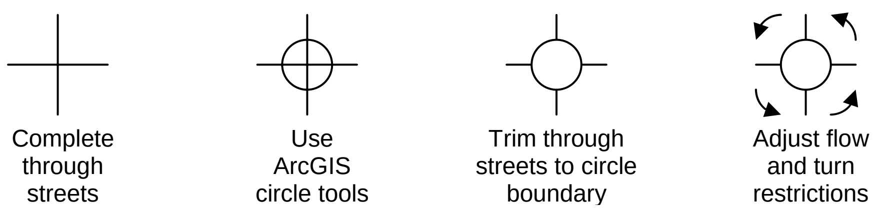
Widening edge of pavement is within the linear feature's edge of pavement

Bulge but with island

G15: *Traffic circles should be represented in the transportation network if the placement of these features necessitated an alignment change in the incoming pathways or if the circle itself has been given a name.*

Traffic circles or roundabouts are traffic calming safety features placed in the center of an intersection. These can vary in size with the placement of larger ones requiring alignment changes to the through streets, forcing a counter-clockwise traffic flow, and often being provided a unique name. Generally, traffic circles should not be represented if the diameter of the circle is less than thirty (30) feet. This distance is measured from the center of pavement of the proposed traffic circle on one side of the island to the center of pavement of the proposed traffic circle on the other side of the island. These are typically small planters placed in the center of an intersection without changes to the street alignments. The through streets should meet at a single end point placed at the center of the circle island. Traffic circles should be represented if the diameter of the circle is greater than thirty (30) feet. Appropriate turn restrictions should be represented to permit only counter-clockwise navigation and addressing should be set to zero (0) on both sides of the traffic circle segments. Large unnamed traffic circles should be given the name “Traffic Circle” with no type.

Traffic circles can be efficiently created in the digital map following the steps illustrated below. Note that address ranges on the straight segments that intersect the traffic circle will need to be adjusted if this method is used.



3.3 Attribute

A01: *TNET feature attributes must only be maintained through the TNET Editor extension.*

The *T*NET Editor extension ensures attribute integrity through coded value domains, range domains, and rules governing tabular relationships. Further, certain attributes are populated dynamically using standard overlays. Bypassing the *T*NET Editor extension by using standard ArcMap table editing tools would bypass the quality control checks programmed within the application and possibly damage the database. Attributes should not be modified by opening the attribute table in ArcMap or through the ArcMap attribute-editing tool as these bypass controls within the *T*NET Editor that ensure data integrity.

A02: *Attribute additions or modifications should be accompanied with appropriate metadata documenting the changes.*

The *T*NET database supports feature level metadata that documents the source for changes and a user comment describing the changes. This information is vital to ensure the ongoing quality of the data.

A03: *Feature names should adhere to the name on the physical demarcation sign (street or road sign, trail marker, or other such signs).*

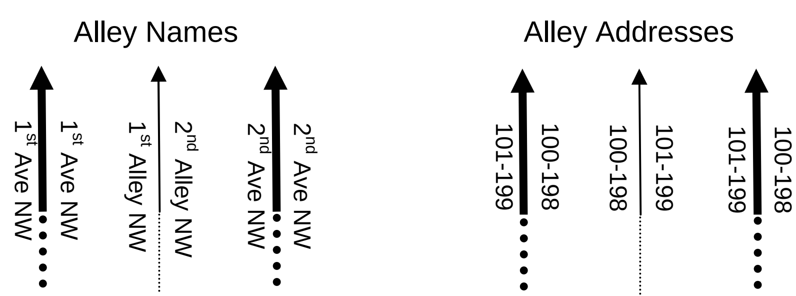
This convention links the physical feature and the digital feature with a name that is attached to both. This facilitates providing directions from the digital map to features that can be identified in the real world. If the name on the demarcation sign includes “Private Road”, then use the full name as the feature name. If the name on the demarcation sign is only “Private Road”, then use “Private” as the name and “Road” as the street type. If there is no physical demarcation, then use “Unnamed” as the name with no street type or directional. The proliferation of “Unnamed” features is not desirable as it complicates labeling, geocoding, trip planning, and routing of emergency services. Every attempt should be made to identify unnamed roads and submit these to the appropriate agency for demarcation.

A04: *Feature names should occur in first letter capitals (e.g., Main not MAIN).*

This convention facilitates feature labeling.

A05: *Alleys should have names and addresses that correspond to both road features that they serve.*

The transportation network data model supports unique names and addresses for both left and right sides of the feature. Although alleys do not have street signs, the names and addresses should be based on the associated road features as illustrated below. This permits proper geocoding and routing through the alleys. The primary name and directional is obtained from the names of the associated roads, and the type is changed to “Alley”. Note that the alley has different names on the left and right sides. Addresses for the alley also correspond to the associated road segments. Addresses for property on the left side of the alley have equivalent addresses to the right side of the corresponding road feature.



Appendix A: System Requirements

Agency Configurations: Responsibility of individual agency unless otherwise noted.

A. Personnel – These functions might be combined within a single individual
   - Consortium Representative
   - Data Maintainer(s)
   - Database Administrator (optional for RDBMS configuration)
   - Hardware Support
B. Software
   - ArcGIS 8.3
   - *T*NET Attribute Editor (supplied by King County Metro Transit)
   - GO! Sync Edit (supplied by King County Metro Transit)
   - ArcSDE 8.3 (optional for RDBMS configuration)
   - RDBMS software - Oracle or SQL Server (optional for RDBMS configuration)
C. Licensing
   - ArcGIS – ArcEditor or ArcInfo
   - GO! Sync Edit (supplied by King County Metro Transit)
   - ArcSDE 8.3 server and connects (optional for RDBMS configuration)
   - RDBMS licenses - Oracle or SQL Server (optional for RDBMS configuration)
D. Hardware – These functions might be combined within a single device*
   - Database Server
   - Application Server
   - Transport Server

* Hardware specifications are dependent upon the number of edits, concurrent editors, ArcSDE implementation, RDBMS, combined functions, and performance requirements. Minimum configuration is a high end PC with 512 Mb RAM and 4 GB free disk space. See master configuration below for maximum required specifications for an agency ArcSDE and RDBMS implementation.

Master Configuration: Responsibility of King County Metro Transit.

A. Personnel – Support contact tnet@metrokc.gov
   - Consortium Representative: Mike Berman
   - Data Maintainers: Trang Bui, Gunnar Goerlitz
   - Database Administrator: Tamara Davis
   - Hardware Engineers: MITT Server Group
B. Software
   - ArcGIS 8.3
   - *T*NET Attribute Editor
   - GO! Sync Edit
   - ArcSDE 8.3
   - Oracle
   - Magi (for Connection Broker)
C. Licensing
   - ArcGIS – ArcInfo
   - GO! Sync Edit
   - ArcSDE 8.3
   - Oracle

D. Hardware
- Database Server: kcmOlympus; two P3 550 MHz CPUs, 3.25 GB Ram
- Application Server: kcmTransport; one P4 3.0 GHz CPU, 512 Mb RAM
- Transport Server: kcmTransport; see above for specifications
- Connection Broker: kcmMagi, one P4 2.2 GHz CPU, 512 Mb RAM

Appendix B: Participants List & Contact Information

Agency	Name	Function	Contact
King County Metro Transit	Mike Berman	Consortium Representative	(206) 263-3732 michael.berman@metrokc.gov
	Trang Bui	Data Maintainer	(206) 684-1593 trang.bui@metrokc.gov
	Gunnar Goerlitz	Data Maintainer	(206) 263-6564 gunnar.goerlitz@metrokc.gov
King County Road Services	Harry Clark Michael Kulish	Consortium Representative Consortium Representative (alternate)	(206) 205-5540 harry.clark@metrokc.gov (206) 296-8222 michael.kulish@metrokc.gov
	Jeff Gregg	Data Maintainer	(206) 296-3715 jeffery.gregg@metrokc.gov
	Brad Fuller	Data Maintainer	(206) 296-8221 brad.fuller@metrokc.gov

Appendix C: Application Interface Controls and Data Domains

Name/Add. Tab:

Control	Type	Description	Domain	Default Value
Name	List Box	Full name for side of feature	Concatenation of assigned prefix, name, type, suffix	None
Category	List Box	Name category for side of feature	Primary, Alt-Primary, Alias	Primary
Juris	List Box	City name for side of feature	Valid city names	Automatically set for new features with city feature class overlay
Zip	Text Input	Zip code for side of feature	Valid five digit zip codes	Automatically set for new features with zip code feature class overlay
Side	List Box	Side of feature based on direction traced	Left, Right	Right
From	Text Input	Address at the “from end” of the feature selected in the Naming section of the tab	Positive integers	None
To	Text Input	Address at the “to end” of the feature selected in the Naming section of the tab	Positive integers	None
Confidence	List Box	Level of confidence in the source data for the address range specified	Low, Medium, High	Low
Theor/Actual	List Box	Address type	Theoretical, Actual	Theoretical
Effective*	Calendar	Date on which the feature is open to traversal by all supported modes	Valid dates	{today}
End*	Calendar	Date on which the feature is closed to traversal by all supported modes	Valid dates	01/01/4000
Copy name from previous	Button	Copies information in the Naming section from the previous feature in the selected set	n/a	n/a

* Default values set when feature created.

Specifications Tab:

Control	Type	Description	Domain	Default Value
Road Class*	List Box	King County road classification	Freeway, Principal Arterial, Collector, Minor Arterial, Non-Arterial	Non-Arterial
US Class*	List Box	Census feature class codes (CFCC)	For complete domain list see http://www.census.gov	A40 Local neighborhood rural road, city street major category
Highway of Statewide Significance	Check Box	Highway of Statewide Significance -- Principal arterials needed to connect major communities as designated by the Washington State legislature	True (checked), False (unchecked)	False
Lanes	Text Input	Total number of lanes in both directions	1..10 (integers only)	2
Lane Width	Text Input	Average lane width (feet) for all lanes in both directions	1..15 (integers only)	12
Rolling Length*	Text Input	Actual distance (feet) traversed by a vehicle as measured by an odometer	Positive real numbers	None
Feature Length*	Info. Display	Feature length (feet)	Positive real numbers	Automatically set for all features
Max Wt.*	Text Input	Maximum allowable vehicle weight (pounds)	1..105,500 (integers only)	105,500
Max Ht.*	Text Input	Maximum allowable vehicle height (feet)	6..20 (integers only)	20
Grade	List Box	Grade change for the feature	less than or = 6%, greater than 6%	less than or = 6%,
Speed Limit*	List Box	Vehicular speed limit	5,10,15,20,25,30,35,40,45, 50,55,60,65,70	35
Copy name from previous	Button	Copies information on this tab from the previous feature in the selected set	n/a	n/a

* Default values set when feature created.

Restrictions Tab (Mode sub-tab):

Control	Type	Description	Domain	Default Value
Mode	List Box	All possible modes	Vehicular – Car, Bicycle, Pedestrian, Rail, Equestrian, Vehicular - Bus	Vehicular – Car
Traffic Flow	List Box	Permitted flow direction based on traced direction	Both, With, Against	Both
Days of Week	List Box	Days of week mode is permitted	All seven days of the week, Monday through Friday, Saturday and Sunday	All seven days of the week
Start Time	Spinner	Start time for the permission	00:00 – 23:59	00:00
End Time	Spinner	End time for the permission	00:00 – 23:59	00:00

Restrictions Tab (Use sub-tab):

Control	Type	Description	Domain	Default Value
Type	List Box	Type of lane restriction	High Occupancy Vehicle, Transit Only	High Occupancy Vehicle
Direction	List Box	Direction of the lane restriction	both directions, with the arc direction, against the arc direction	Both directions
Start Time	Spinner	Start time for the restriction	00:00 – 23:59	00:00
End Time	Spinner	End time for the restriction	00:00 – 23:59	00:00
Days of Week	List Box	Days of week restriction occurs	All seven days of the week, Monday through Friday, Saturday and Sunday	All seven days of the week

Restrictions Tab (Turn sub-tab):

Control	Type	Description	Domain	Default Value
Available Modes	List Box	Mode for turn restriction display	Permitted modes identified on the Mode sub-tab	n/a
Edge End	Info. Display	End of edge turning from	From, To	n/a
Edge To	Info. Display	Edge name turning to	Valid feature names	n/a
Turn	List Box	Indication if turn is or is not restricted	Restricted, Not Restricted	n/a
Start Time	Spinner	Start time for the restriction	00:00 – 23:59	00:00
End Time	Spinner	End time for the restriction	00:00 – 23:59	00:00
Days of Week	List Box	Days of week restriction occurs	All seven days of the week, Monday through Friday, Saturday & Sunday	All seven days of the week

Metadata Tab:

Control	Type	Description	Domain	Default Value
Modification	Info. Display	Date on which the record was modified	Valid dates	n/a
Edit Agency	Info. Display	User name performing the modification	*T*NET Consortium member agency users	n/a
Action	Info. Display	The edit operation performed	Create, Delete, Attribute, Geometry	n/a
Table	Info. Display	Table modified	*T*NET Geodatabase tables	n/a
Attribute	Info. Display	Column modified in the table	Columns for specified table	n/a
Previous Value	Info. Display	Original value prior to modification	Varies depending on value	n/a
New Value	Info. Display	New value after modification	Varies depending on value	n/a
Revision Source	Text Input	Source of the selected modification	Text	None
Revision Details	Text Input	Notes documenting the change	Text	None

All Tabs:

Control	Type	Description
Link ID	Info. Display	Unique identifier for the feature. This is a composite key with the first two digits representing a unique identifier for each agency.
Link	Info. Display	The current feature in the selected set.
Show Arc Direction	Checkbox	Displays a graphic at the “to end” of the feature showing the direction the feature was traced.
Show Mode Direction	Checkbox	Displays graphics in middle of feature showing permitted travel directions for specified mode.
(Mode)	List Box	The specified mode for the Show Mode Direction control.
Auto Zoom	Checkbox	Automatically sets the display extent to the current feature in the selected set.
Zoom Feature	Button	Sets the display extent to the current feature in the selected set.
Zoom All	Button	Sets the display extent to all the features in the selected set.
Flash Feature	Button	Flashes the current feature in the selected set.
Back	Button	Advances the interface to the previous feature in the selected set.
Next	Button	Advances the interface to the next feature in the selected set.
OK	Button	Saves all changes and dismisses the *T*NET Editor interface.
Cancel	Button	Dismisses the *T*NET Editor interface without saving changes.

Create New Name Form:

Control	Control Type	Description	Domain	Default Value
Prefix	List Box	Directional preceding the name	N, S, E, W, NE, NW, SE, SW	None
Name	List Box with Text Input	Name of the feature	Valid street names	None
Type	List Box	Feature type	Valid types based on US Postal standards: AcRd, Aly, Ave, Blvd, Brg, Cir, Cres, Ct, Ctf, Dr, Expy, Fwy, Holw, Hwy, Ky, Ln, Loop, Mall, Opas, Park, Pkwy, Pl, Ramp, Rd, Rise, St, Str, Ter, Trl, Tunl, Vis, Walk, Way	None
Suffix	List Box	Directional following the name	N, S, E, W, NE, NW, SE, SW	None
Add	Button	Add the name to the list of street names.	n/a	n/a
OK	Button	Adds the name to the list of street names and dismisses the form.	n/a	n/a
Cancel	Button	Dismisses the form.	n/a	n/a

Appendix D: Glossary

Term	Definition
ArcSDE	ESRI's gateway to a multi-user commercial RDBMS. It is an open, high-performance spatial data server that employs client/server architecture to perform efficient spatial operations and manage large, shared geographic data.
Bandwidth	The data rate supported by a network connection or interface.
Chicane	A traffic calming device composed of two or three curb bulbs that are staggered on either side of a street to narrow it. Drivers must do a S-shaped maneuver to get through them.
Conflation	A process by which two digital maps are matched and merged into one.
Consortium Representative	A designated member of the *T*NET Consortium.
Data Maintainer/Editor	An individual assigned to maintaining *T*NET geographic features, tabular records, or both.
DEM	See Digital Elevation Model
Digital Elevation Model	Continuous raster layers in which data file values represent elevation.
GDT	See Geographic Data Technologies
Geographic Data Technologies	A geographic data mapping vendor. Recently purchased by Tele Atlas.
Management Information and Transit Technology	An information technology section within the King County Department of Transportation Transit Division.
Master Environment	The core, independent and self-sustaining environment including hardware, software, database and staff within King County's firewall, including the Connection Broker outside that firewall.
Master Repository	The core database storing all synchronized changes from replicated databases housed at each agency site.
MITT	See Management Information and Transit Technology
Personal Geodatabase	A modern GIS data model for storing geographic and tabular data within a single database. A personal geodatabase uses the Microsoft Jet Engine and provides limited storage and single user access capabilities.
PGDB	See Personal Geodatabase
Pseudo node	A node where two, and only two, lines intersect, or where a single linear feature connects with itself.
RDBMS	See Relational Database Management System

Term	Definition
Relational Database Management System	A program that allows you to create, update, and administer a relational database (e.g., Oracle®, Microsoft® SQL Server™)
TNET	See Transportation Network
*T*NET Consortium	An entity comprised of those King County departments, regional transit agencies and municipal governments which participate in shared data maintenance of the transportation network.
*T*NET Program	An integrated maintenance program to produce a comprehensive, optimally accurate and current geodatabase comprising all transportation-related spatial and attribute datasets for the King County region.
Transportation Network	A multi-modal GIS transportation line data layer and associated attribute database housed on King County servers.
UNETRANS	See Unified Network for Transportation
Unified Network for Transportation	A generic ESRI-centric data model intended for ESRI users developing transportation-specific applications formulated by a consortium of academics, ESRI software users, and business partners.
WAN	See Wide Area Network
Wide Area Network	A computer network that spans a relatively large geographical area.

END OF ATTACHMENT B